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Credit and Counterparty Risk

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Background

- For insurers most credit risk arises from asset portfolios
- Immaterial whether resulting risk is categorised as “market risk” or “credit risk” or a combination of the two
- Risk affects return expectations as well as capital requirements
- Counterparty risk is generally considered alongside credit risk, although mitigation / management strategies may differ

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Agenda

- Understanding credit risk
- Measuring credit risk
- Calibrating credit models
- Managing credit risk

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Market risk and risk capital (1)

- Market risk (including credit risk) can be considered in three categories:
  1. Changes in the time-value of risk-free money
     - i.e. risk-free yield curve moves
  2. Changes in the market's expectation of the distribution of future asset cashflows
     - e.g. equity dividends, corporate bond coupons
  3. Changes in the market's required risk premium for the risks embedded in the above distribution of future cashflows

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Market risk and risk capital (2)

- Disaggregation of sources (2) and (3) is empirically very difficult:
  - Is credit spread volatility solely due to changes in the market's expectations of default rates?
  - Or changes in the level of risk premium required for bearing default risk?
  - Or a mixture of both?
  - (Similar questions for equities, risk-free bonds, options, etc.)
- But source (3) will generate mean reversion in long-term returns, while source (2) probably won't
- And source (2) will impact directly on any RBC measure while source (3) may not

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What is solvency capital for?

- Do regulators want long-term insurers to hold capital so that:
  - They will (nearly) always be able to transfer liabilities to a third party
  - They will (nearly) always be able to pay their liabilities
- That is, short-term risk transfer or long-term risk funding?
- These are fundamentally different
- And what is the appropriate probability level in each case?
- FSA bias (and hence Solvency II) is towards short-term risk transfer, with 99.5% probability

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Measuring credit risk

- Long-term credit risk can be estimated using a combination of probability of default (PD), exposure at default (EAD) and loss given default (LGD)
- A coherent modelling framework needs to allow for correlations between defaults and between credit and other market risks
- Model should also allow consistent estimation of risk for a variety of credit-based assets such as CDOs
- As always, calibrating tail events requires substantial judgement as well as suitable data
- Model may need to cover short-term spread volatility as well

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Approaches to Credit Modelling

- Structural approach (Merton)
  - Explicitly model the firm's assets and liabilities to determine default events
  - Default probabilities (and hence bond spreads etc) are a function of the firm's volatility and moneyness
- Reduced-form approach
  (Jarrow-Lando-Turnbull; Duffie-Singleton)
  - Describe the probability of default occurring without care for "why" default occurs
  - Can be thought of as a special case of the structural approach
  - Probability of default described by a credit transition matrix
  - Incorporate correlation between individual bond transitions

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A sample credit transition matrix

Annual Transition Matrix: Rating at End of Period

Rating at Start of Period	*AAA*	*AA*	*A*	*BBB*	*BB*	*B*	*CCC*	*Default*
AAA	88.0%	10.6%	0.9%	0.2%	0.3%	0.0%	0.0%	0.0%
AA	3.9%	88.0%	6.7%	0.9%	0.3%	0.3%	0.0%	0.0%
A	0.2%	5.4%	87.8%	5.3%	0.8%	0.4%	0.0%	0.1%
BBB	0.1%	0.6%	9.6%	82.5%	5.3%	1.3%	0.2%	0.4%
BB	0.1%	0.3%	1.1%	9.7%	79.2%	7.2%	0.9%	1.7%
B	0.0%	0.2%	0.4%	0.8%	6.3%	85.4%	2.7%	4.2%
CCC	0.0%	0.0%	1.5%	1.5%	2.6%	9.6%	70.4%	14.5%
Default	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

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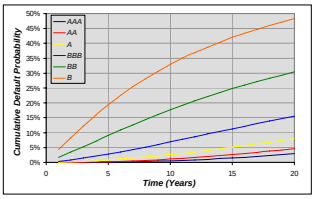
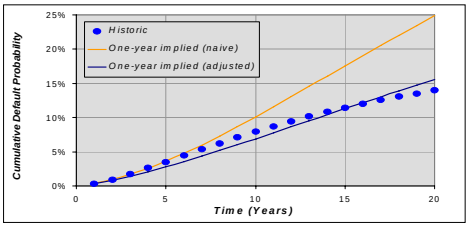
Cumulative default probabilities

- Transitions are Markov
  - "Power-up" matrix to calculate matrix for any time interval
  - In particular can calculate cumulative default probabilities



Calibration of transition matrix

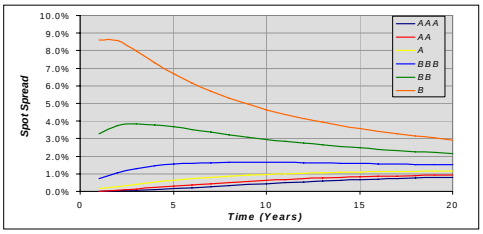
- B&H adjust historic transition matrix to be consistent with historic cumulative default rates



B&H model: stochastic credit spreads

- Assume a fixed proportion of promised cash flows recovered in the event of default (varies by seniority)
- Assume investors require a risk premium to compensate for potential default losses
- Assume credit risk premium parameter follows a stochastic process like Cox-Ingersoll-Ross interest rate model
  - Mean reversion
  - Positive spreads
  - Analytic bond prices

Example risk-adjusted spreads



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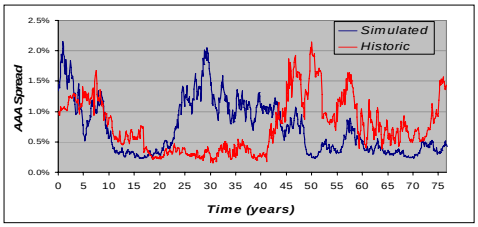
Short-term spread volatility: example scenario



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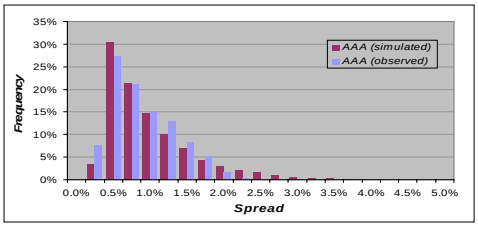
Calibration: spread distributions



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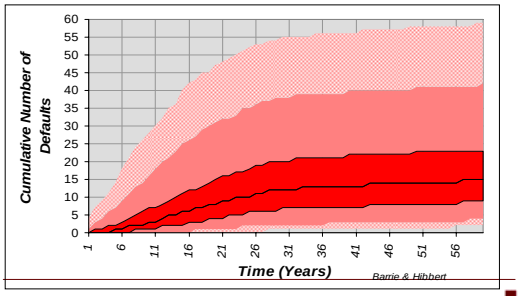
Cumulative defaults: example portfolio



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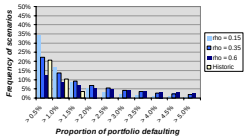
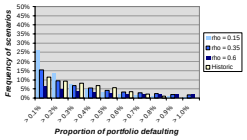
Annual defaults: alternative calibrations

AA-rated issuers



BBB-rated issuers



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Transition / default results & sensitivity to correlation

- Tables show mean and 99.5% figures for 1 year downgrades and defaults losses, expressed as % of portfolio
- Lack of historic data means tail calibration is a matter of judgement

Downgrades

	Correlation 35%	25%
AAA	6 / 51	6 / 38
AA	9 / 58	9 / 45
A	4 / 44	4 / 33
BBB	5 / 45	5 / 36
BB	8 / 55	8 / 42

Defaults

	Correlation 35%	25%
AAA	0.0 / 0.7	0.0 / 0.7
AA	0.1 / 2.0	0.1 / 2.0
A	0.1 / 3.3	0.1 / 2.6
BBB	0.4 / 6.5	0.4 / 5.2
BB	1.3 / 15.6	1.3 / 11.7

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Credit risk: annuity ICA survey

- Form of credit stress varies between companies:

No explicit allowance for spread widening. Downgrades and defaults modelled by stressing historic downgrade probabilities and consequent expected losses
Single (combined) stress that varies by rating and duration (x2)
Single stress that varies by rating (x2)
Defaults modelled over run-off using internal model calibrated to historic experience and Moody's data
Fall in corporate bond values as part of wider multivariate market risk scenario including equity, credit and interest rates
Default/ migration risk modelled as increase to spread stress that varies by rating and duration
Stress that varies by rating, split using specialist credit risk system into default, downgrade and general spread widening components
Spread widening stress that varies by rating, together with loss stress arising from ratings transitions
Fall in corporate bond values as part of wider multivariate market risk scenario including equity, credit and interest rates (using the B&H Economic Scenario Generator)
Internal stochastic model calibrated using historic data

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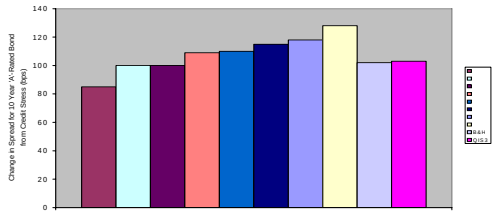
Credit risk survey: spread widening for 10 year 'A'-rated bond



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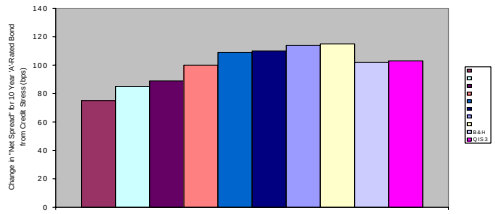
Credit risk survey: "Net" spread widening



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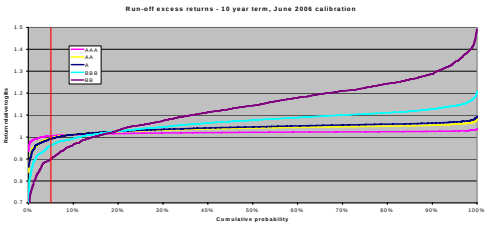
Effect of run-off: 10 year return distributions



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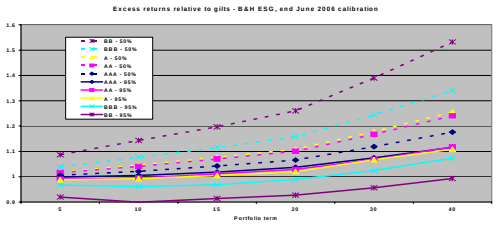
Run-off credit returns



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Managing credit and counterparty risk

- Measuring risk is precursor to managing risk
- Monitoring systems must enable combined exposures to be calculated
- Hygiene factors
  - Collateralisation
  - Offsetting
  - Diversification
- Primary management tool is via investment strategy …

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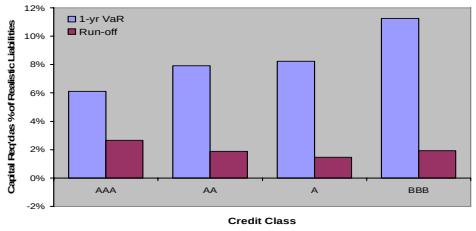
Annuity business example: impact of asset strategy on ICA numbers



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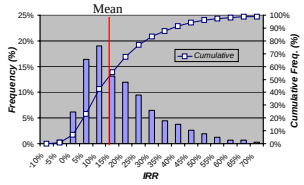
Annuity business example: distribution of realised IRR



- Credit and longevity risk create uncertainty in realised IRR
- Pricing on 100% of statutory valuation with 'A'-rated investment strategy, our model implies probability of negative return on capital is 1%
- Compare distributions for other strategies

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Conclusions

- Need to understand how credit risk impacts business – run-off and VaR are different
- Calibrating robust credit models is hard
- Need coherent framework that extends to, say, structured credit
- Risk is about return as well as capital

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